FLUKE®

Calibration

9102S

Dry-Well Calibrator

Users Guide

9102S___ugeng0000

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1 Before You Start

1.1 Introduction

The Fluke Calibration 9102S Mid-Range Field Calibrator is a small portable instrument designed for quick on-site checks and calibration of thermocouple and RTD temperature probes. This instrument is small enough to use in the field, and accurate enough to use in the lab. Calibrations may be done over a range of –10°C to 122°C (14°F to 252°F). Temperature display and setpoint resolution are 0.1 degrees.

The instrument features:

- A controlled temperature block with two calibration insert sleeves
- Rapid heating and cooling
- Prop stand
- Handle strap
- RS-232 interface capability
- +12 Volt DC battery option

Built in programmable features include:

- Temperature scan rate control
- Eight set-point memory
- Adjustable readout in °C or °F

The temperature is accurately controlled by Fluke's digital controller. The controller uses a precision platinum RTD as a sensor and controls the well temperature with transistor driven thermoelectric devices.

The LED front panel shows the current well temperature. The temperature may be set, using the control buttons, to any desired temperature within the instrument's range. Multiple fault protection devices insure user and instrument safety and protection.

This dry-well calibrator was designed for portability, low cost, and ease of operation. Through proper use and maintenance, the instrument will provide continued accurate calibration of temperature sensors and devices. The user should be familiar with the safety guidelines and operating procedures of the calibrator as described in the instruction manual.

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1.2 Symbols

Table 1 lists the International Electrical Symbols. Some or all of these symbols may be used on the instrument or in this manual.

Table 1 *International Electrical Sympols used on products*

Symbol	Description
	AC (Alternating Current)
	AC-DC
	Battery
	Complies with European Union directives
	DC
	Double Insulated
	Electric Shock
	Fuse
	PE Ground
	Hot Surface (Burn Hazard)
	Read the User's Guide (Important Information)
	Off
	On
	Canadian Standards Association

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Symbol	Description
	C-TICK Australian EMC mark
	The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) mark.

1.3 Safety Information

Use this instrument only as specified in this manual. Otherwise, the protection provided by the instrument may be impaired. Refer to the safety information in the Warnings and Cautions sections below.

The following definitions apply to the terms “Warning” and “Caution”.

- “Warning” identifies conditions and actions that may pose hazards to the user.
- “Caution” identifies conditions and actions that may damage the instrument being used.

1.3.1 ⚠ WARNINGS

To avoid personal injury, follow these guidelines.

GENERAL

- **DO NOT** use this instrument in environments other than those listed in the User’s Guide.
- Inspect the instrument for damage before each use. **DO NOT** use the instrument if it appears damaged or operates abnormally.
- Follow all safety guidelines listed in the user’s manual.
- Calibration Equipment should only be used by Trained Personnel.
- If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- Before initial use, or after transport, or after storage in humid or semi-humid environments, or anytime the dry-well has not been energized for more than 10 days, the instrument needs to be energized for a “dry-out” period of 2 hours before it can be assumed to meet all of the safety requirements of the IEC 1010-1. If the product is wet or has been in a wet environment, take necessary measures to remove moisture prior to applying power such as storage in a low humidity temperature chamber operating at 50 degree centigrade for 4 hours or more.
- **DO NOT** use this instrument for any application other than calibration work. The instrument was designed for temperature calibration. Any other use of the instrument may cause unknown hazards to the user.
- Completely **unattended operation is not recommended.**

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- Overhead clearance is required. **DO NOT** place the instrument under a cabinet or other structure. Always leave enough clearance to allow for safe and easy insertion and removal of probes.
- If the instrument is used in a manner not in accordance with the equipment design, the operation of the dry-well may be impaired or safety hazards may arise.
- This instrument is intended for indoor use only.

BURN HAZARDS

- **DO NOT** turn the instrument upside down with the inserts in place; the inserts will fall out.
- **DO NOT** operate near flammable materials.
- Use of this instrument at **HIGH TEMPERATURES** for extended periods of time requires caution.
- **DO NOT** touch the well access surface of the instrument.
- The block vent may be very hot due to the fan blowing across the heater block of the dry-well.
- The temperature of the well access is the same as the actual display temperature, e.g. if the instrument is set to 375°C and the display reads 375°C, the well is at 375°C.
- For top loading dry-wells, the top sheet metal of the dry-well may exhibit extreme temperatures for areas close to the well access.
- The air over the well can reach temperatures greater that 200°C for high temperature (400°C and higher) dry-wells. **Note:** Probes and inserts may be hot and should only be inserted and removed from the instrument when the instrument is set at temperatures less than 50°C. Use extreme care when removing hot inserts.
- **DO NOT** turn off the instrument at temperatures higher than 100°C. This could create a hazardous situation. Select a set-point less than 100°C and allow the instrument to cool before turning it off.
- The high temperatures present in dry-wells designed for operation at 300°C and higher may result in fires and severe burns if safety precautions are not observed.
- A fire may occur if a short circuit occurs along the input cord and no protective devices are on the DC input source. For short circuit protection using a battery, a fuse is required at the battery terminals.
- ELECTRICAL SHOCK
- **DO NOT** operate this instrument without a properly grounded, properly polarized power cord. Electric shock may result.
- **DO NOT** connect this instrument to a non-grounded, non-polarized outlet. Ensure the earth ground to the outlet is properly connected. Electrical shock may result if the outlet is not installed correctly.
- Always replace the power cord with an approved cord of the correct rating and type.

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- **HIGH VOLTAGE** is used in the operation of this equipment. **SEVERE INJURY** or DEATH may result if personnel fail to observe safety precautions. Before working inside the equipment, turn power off and disconnect power cord.
- If supplied with user accessible fuses, always replace the fuse with one of the same rating, voltage and type.

BATTERY PACK

- To avoid the risk of electric shock or fire, do not use the charger outdoors or in a dusty, dirty, or wet environment.
- If the cord, case, or plug of the charger is damaged in any way, discontinue its use immediately and have it replaced. Never disassemble the charger.
- The battery may contain chemicals that are hazardous. To avoid the risk of exposure to dangerous substances or explosion, immediately discontinue use of the battery if it leaks or becomes damaged. Never allow the battery to be shorted, heated, punctured, dropped, or crushed.
- Store the battery where it will not come into contact with metal or fluids that might short circuit the battery and where it will be safe from excessive temperatures.
- When no longer usable, the battery must be recycled. The battery may be returned to the seller for recycling. Do not dispose of the battery in a landfill.
- Never dispose of the battery in fire as there is danger of explosion which may cause injury or property damage.

1.3.2 ⚠ CAUTIONS

- Always operate this instrument at room temperature between 41°F and 122°F (5°C to 50°C). Allow sufficient air circulation by leaving at least 6 inches (15 cm) of clearance around the instrument.
- Component lifetime can be shortened by continuous high temperature operation.
- **DO NOT** use fluids to clean out the well.
- **Never introduce any foreign material** into the probe hole of the insert. Fluids, etc. can leak into the instrument causing damage.
- **DO NOT** change the values of the calibration constants from the factory set values. The correct setting of these parameters is important to the safety and proper operation of the calibrator.
- **DO NOT** drop the probe sheath in to the well. This type of action can cause a shock to the sensor and affect the calibration.
- The instrument and any thermometer probes used with it are sensitive instruments that can be easily damaged. Always handle these devices with care. **DO NOT** allow them to be dropped, struck, stressed, or overheated.
- The Factory Reset Sequence (see Section , Troubleshooting) should be performed only by authorized personnel if no other action is successful in

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correcting a malfunction. You must have a copy of the most recent Report of Calibration to restore the calibration parameters.

- **DO NOT** operate this instrument in an excessively wet, oily, dusty, or dirty environment. Always keep the well and inserts clean and clear of foreign material.
- The dry-well is a precision instrument. Although it has been designed for optimum durability and trouble free operation, it must be handled with care. Always carry the instrument in an upright position to prevent the probe sleeves from falling out. The convenient handle strap allows for one hand carrying.
- If a mains supply power fluctuation occurs, immediately turn off the instrument. Power bumps from brown-outs could damage the instrument. Wait until the power has stabilized before re-energizing the instrument.
- The prop stand was not designed to be used as a handle for carrying the instrument. To avoid damage, do not force the prop stand beyond the incline positions of the instrument.
- Allow for probe expansion inside the well as the block heats.
- Most probes have handle temperature limits. Be sure that the probe handle temperature limit is not exceeded in the air above the instrument.

1.4 Authorized Service Centers

Please contact one of the following authorized Service Centers to coordinate service on your Fluke product:

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When contacting these Service Centers for support, please have the following information available:

- Model Number
- Serial Number
- Voltage
- Complete description of the problem

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2 Specifications and Environmental Conditions

2.1 Specifications

Table 2 *Specifications*

Range	–10°C to 122°C (14°F to 252°F) at an ambient of 23°C
Accuracy	±0.25°C
Stability	±0.05°C
Resolution	0.1°C or °F
Well-to-Well Uniformity	±0.2°C with sensors of similar size at equal depths within wells
Heating Times	ambient to 100°C: 10 minutes
Stabilization	7 minutes
Cooling Times	ambient to 0°C: 10 minutes
Well Depth	4 inches (102 mm)
Removable Inserts	refer to Section , Accessories
Power	94–234 VAC (±10%), 50/60 Hz, 50 W; or 12 VDC
Size	4" H x 6" W x 6.9"D (100 mm x 152 mm x 175 mm)
Weight	4 lb. (1.8 Kg)
Safety	Conforms to EN61010-1 Conforms to CAN/CSA C22.2 No.1010.1 UL3111 and ANSI/ISA-S82.01
Fault Protection	Sensor burnout protection, over-temperature cutout, and electrical fuses
Fuse Rating	250 V, 3 A FF (very fast acting) NO USER SERVICEABLE PARTS

2.2 Environmental Conditions

Although the instrument has been designed for optimum durability and trouble-free operation, it must be handled with care. The instrument should not be operated in an excessively dusty or dirty environment. Maintenance and cleaning recommendations can be found in the Maintenance Section of this manual.

The instrument operates safely under the following conditions:

- temperature range: 5–50°C (41–122°F)
- ambient relative humidity: 15–50%
- pressure: 75kPa–106kPa
- mains voltage within ±10% of nominal
- vibrations in the calibration environment should be minimized
- altitudes less than 2000 meters
- indoor use only

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3 Quick Start

3.1 Unpacking

Unpack the dry-well carefully and inspect it for any damage that may have occurred during shipment. If there is shipping damage, notify the carrier immediately.

Verify that the following components are present:

- 9102S Dry-well
- Power Cord
- User's Guide with Report of Calibration
- RS-232 Cable
- 9930 Interface-it Software
- 3102-3 Insert, 3/16"
- 3102-4 Insert, 1/4"
- Insert Removal Tool

3.2 Set-up

Place the calibrator on a flat surface with at least 6 inches of free space around the instrument. Always leave enough clearance in front of the instrument to allow for safe and easy insertion and removal of probes. The prop stand may be swung down to raise the front of the instrument from a horizontal position. Plug the power cord into a grounded mains outlet. Observe that the nominal voltage corresponds to that indicated on the calibrator.

Turn on the power to the calibrator by toggling the power switch on. The fan should begin quietly blowing air through the instrument and the controller display should illuminate after 3 seconds. After a brief self-test the controller should begin normal operation. If the unit fails to operate, check the power connection.

The display should show the well temperature and the well heater will bring the temperature of the well to the set-point temperature.

After using the calibrator, allow the well to cool by setting the temperature to 25°C and waiting 1/2 hour before turning the instrument off.

3.3 AC Power Operation

Plug the dry-well power cord into a mains outlet of the proper voltage, frequency, and current capability. Refer to Section 3.1, Specifications, for the power details. Turn the dry-well on using the switch on the rear panel. The dry-well will turn on and begin to heat to the previously programmed temperature set-point. The front panel LED display will indicate the actual dry-well temperature.

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3.4 DC Power Operation

This instrument is equipped with a DC power option. The DC option requires a power source that delivers 12 VDC at 3 amps.

WARNING: *A fire may occur if a short circuit occurs along the input cord and no protective devices are on the DC input source. For short circuit protection using a battery, a fuse is required at the battery terminals.*

The DC power socket is located on the rear panel of the instrument near the AC power jack. The instrument accepts a 7/32 inch diameter, two-conductor DC power plug such as Switchcraft® PN. 760. Observe the correct polarity as shown in Figure . The outside conductor is positive and the inside is negative. The AC power switch on the rear panel does not switch the DC power.

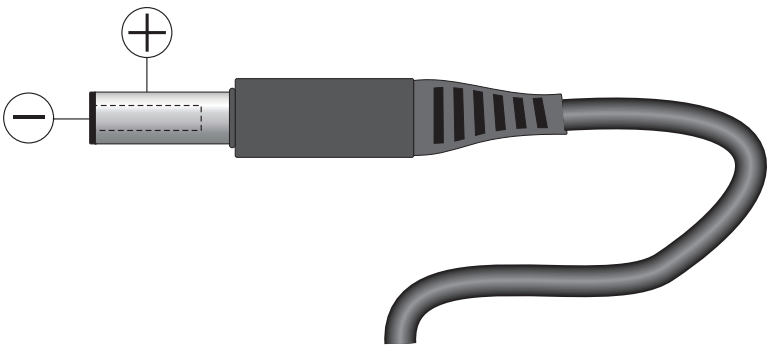

Figure 1 *12 V DC Power Source Polarity*

The optional Model 9320A Battery Pack, available from Fluke, can be used as a portable power source.

3.5 Setting the Temperature

Section 6.2, Temperature Set-point, on page 19 explains in detail how to set the temperature set-point on the calibrator using the front panel keys. The procedure is summarized here.

1. Press “SET” twice to access the set-point value.
2. Press ▲ or ▼ arrow to change the set-point value.
3. Press “SET” to program in the new set-point.
4. Press and hold “EXIT” to return to the temperature display.

When the set-point temperature is changed the controller switches the well heater on or off to raise or lower the temperature. The displayed well temperature gradually changes until it reaches the set-point temperature. The well may require 5 to 10 minutes to reach the set-point depending on the span. Another 5 to 10 minutes is required to stabilize within ±0.1°C of the set-point. Ultimate stability may take 15 to 20 minutes more of stabilization time.

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4 Parts and Controls

The user should become familiar with the dry-well calibrator and its parts: (See Figure 2 on this page and Figure 3 on next page).

4.1 Rear Panel

Power Cord - The removable power cord, (Figure) attaches to the back side of the instrument. It plugs into a standard 115 VAC (optional 230 VAC) grounded socket.

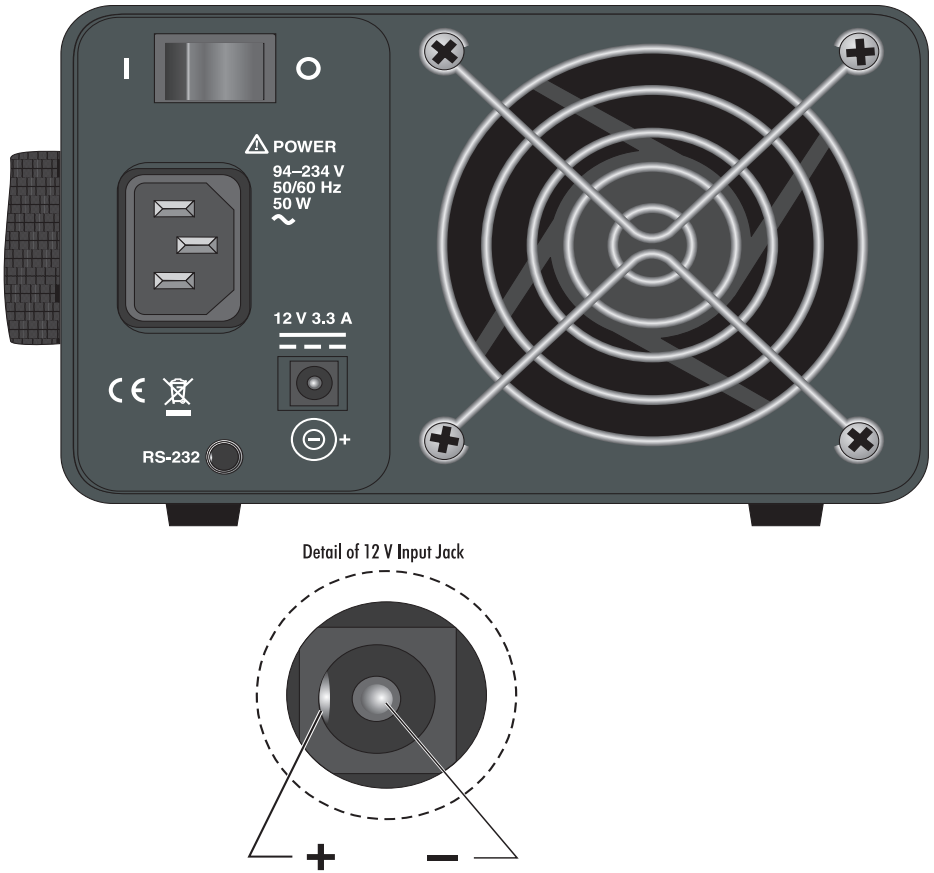

Figure 2 *Back Panel*

DC Power Jack - The calibrator can be used with a DC power source. The DC input jack requires 12V and 3.3 amps. See Figure and the inset of Figure for pinout.

Power Switch - The power switch is located on the back panel of the instrument. The switch is either on or off. The on position is for normal operation. The off position disconnects power to the entire unit.

Fan - The instrument utilizes a variable speed fan. Under certain circumstances, the fan may turn off. The fan shuts off at 100°C and above. Slots at the top and around the

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corners of the instrument are provided for airflow. The area around the calibrator must be kept clear to allow for adequate ventilation. The air is directed from the front to the back. Allow 6 inches of open space around the calibrator to allow adequate ventilation.

RS-232 - The RS-232 serial port provides a means for connecting the instrument to a computer or a printer using the included serial cable.

WARNING: *Always leave enough clearance in front of the calibrator to allow for safe and easy installation and removal of probes.*

4.2 Front Panel

Figure 3 *Front Panel*

Strap - A strap is provided to aid the user in carrying the instrument in one hand. Slide your hand into position and secure using the Velcro for a tight fit. Be careful when carrying the instrument while using the strap as inserts can fall out of the wells when tipped forward. Inspect the strap periodically for wear.

Well Block - Located on the middle of the front panel are the well openings where probes may be inserted into the well. The block is designed to accept temperature sensors up to 1/2" (12.7 mm) in diameter. The wells can be made to accept probes of smaller than 1/2" (12.7 mm) diameter by using optional inserts. Probes should fit snugly into the wells for best results.

Controller Display - The digital display is an important part of the temperature controller because it not only displays set and actual temperatures but also indicates various calibrator functions, settings, and constants. The display shows temperatures in units according to the selected scale °C or °F.

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Controller Keypad - The four button keypad allows easy setting of the set-point temperature. The control buttons (SET, ▼, ▲, and EXIT) are used to set the calibrator temperature set-point, access and set other operating parameters, and access and set calibration parameters.

Setting the control temperature is done directly in degrees of the current scale. It can be set to one-tenth of a degree Celsius or Fahrenheit.

The functions of the buttons are as follows:

SET – Used to display the next parameter in the menu and to store parameters to the displayed value.

▼ (down arrow) – Used to decrement the displayed value of parameters.

▲ (up arrow) – Used to increment the displayed value.

EXIT – Used to exit a function and to skip to the next function. Any changes made to the displayed value are ignored.

4.3 Accessories

The table below lists optional inserts, carrying case, and battery packs by model number.

Table 3 *Accessories*

Model	Description
3102-0	Blank Insert
3102-1	1/16 (1.6 mm) Insert
3102-2	1/8 (3.2 mm) Insert
3102-8	5/32 (4.0 mm) Insert
3102-3	3/16 (4.8 mm) Insert
3102-4	1/4 (6.4 mm) Insert
3102-5	5/16 (7.9 mm) Insert
3102-6	3/8 (9.5 mm) Insert
3102-7	7/16 (11.1 mm) Insert
9308	Rugged Carrying Case
9320A	Battery Pack

Call your local Fluke representative for current pricing.

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5 General Operation

5.1 Setting the Temperature

Section 6.2, Temperature Set-point, on page 19 explains in detail how to set the temperature set-point on the calibrator using the front panel keys. The procedure is summarized here.

1. Press “SET” twice to access the set-point value.
2. Press ▲ or ▼ to change the set-point value.
3. Press “SET” to program in the new set-point.
4. Press and hold “EXIT” to return to the temperature display.

When the set-point temperature is changed the controller switches the well heater on or off to raise or lower the temperature. The displayed well temperature gradually changes until it reaches the set-point temperature. The well may require 5 to 10 minutes to reach the set-point depending on the span. Another 5 to 10 minutes is required to stabilize within ±0.05°C of the set-point. Ultimate stability may take 15 to 20 minutes more of stabilization time.

5.2 Changing Display Units

This instrument can display temperature in Celsius or Fahrenheit. The temperature units are shipped from the factory set to Celsius. There are two ways to change to Fahrenheit or back to Celsius.

1 - Press the “SET” and ▲ simultaneously. The temperature display changes units.

or

1 - Press the “SET” key three times from the temperature display to show

Un= C

2 - Press the ▲ or ▼ key to change units.

3 - Press “SET” to save the setting or “EXIT” to continue without changing the setting.

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6 Controller Operation

This chapter discusses in detail how to operate the dry-well temperature controller using the front control panel. Using the front panel key-switches and LED display the user may monitor the well temperature, set the temperature set-point in degrees C or F, monitor the heater output power, adjust the controller proportional band, and program the calibration parameters, operating parameters, and serial interface configuration. Operation of the functions and parameters are shown in the flowchart in Figure 4 on next page. This chart may be copied for reference.

In the following discussion a button with the word SET or EXIT inside, a ▲, or ▼, indicates the panel button while the dotted box indicates the display reading. Explanations of the button or display reading are to the right of each button or display value.

6.1 Well Temperature

The digital LED display on the front panel allows direct viewing of the actual well temperature. This temperature value is normally shown on the display. The units, C or F, of the temperature value are displayed at the right. For example,

`100.0 C` *Well temperature in degrees Celsius*

The temperature display function may be accessed from any other function by holding and releasing the "EXIT" button.

6.2 Temperature Set-point

The temperature set-point can be set to any value within the range and with resolution as given in the specifications. Be careful not to exceed the safe upper temperature limit of any device inserted into the well.

Setting the temperature involves selecting the set-point memory and adjusting the set-point value.

6.2.1 Programmable Set-points

The controller stores 8 set-point temperatures in memory. The set-points can be quickly recalled to conveniently set the calibrator to a previously programmed temperature set-point.

To set the temperature, first select the set-point memory. This function is accessed from the temperature display function by pressing "SET". The number of the set-point memory currently being used is shown at the left on the display followed by the current set-point value.

`100.0 C` *Well temperature in degrees Celsius*

SET *Access set-point memory*

`1 100.` *Set-point memory 1 location, 100°C currently used*

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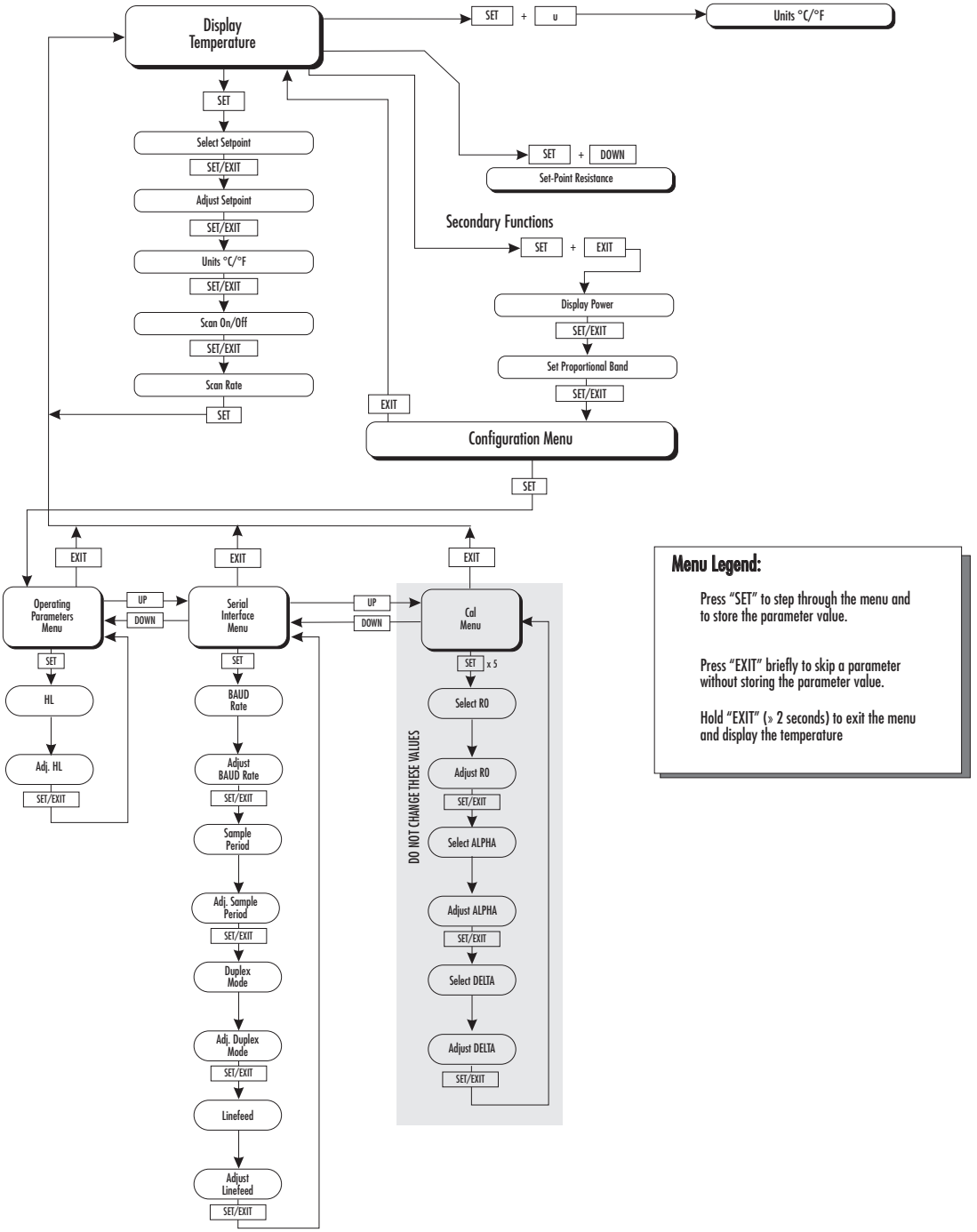

Figure 4 *Controller operation flowchart*

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To change to another set-point memory press the up or down arrow.

4 50. *New set-point memory 4 location, 50°C*

Press “SET” to accept the new selection and access the set-point value. Press “EXIT” to continue and to ignore any changes.

Accept selected set-point memory

6.2.2 Set-point Value

The set-point value may be adjusted after selecting the set-point memory and pressing “SET”.

4 50. *Set-point 4 value in°C*

If the set-point value does not need to be changed, press and hold “EXIT” to resume displaying the well temperature. To change the set-point value, press “SET” and then press the up or down arrow.

60. *New set-point value*

When the desired set-point value is reached, press “SET” to accept the new value and access the temperature scale units selection. If “EXIT” is pressed, any changes made to the set-point are ignored.

Accept new set-point value

6.2.3 Temperature Scale Units

The temperature scale units of the controller maybe set by the user to degrees Celsius (°C) or Fahrenheit (°F). The units are used in displaying the well temperature, set-point, proportional band, and high limit.

Press “SET” after adjusting the set-point value to change display units.

Un= C *Scale units currently selected*

Press the up or down arrow to change the units.

Un= F *New units selected*

Press “SET” to accept the new units or “EXIT” to cancel.

Note: The temperature scale units may also be changed by pressing “SET” and ▲ when the temperature is displayed.

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6.3 Scan

The scan rate can be set and enabled so that when the set-point is changed the dry-well heats or cools at a specified rate (degrees per minute) until it reaches the new set-point. With the scan disabled the dry-well heats or cools at the maximum possible rate.

6.3.1 Scan Control

The scan is controlled with the scan on/off function that appears in the main menu after the temperature scale units.

Sc	*Sc flashes for one second and then the current scan setting is displayed*
OFF	*Scan function off*

Press the up or down arrow to toggle the scan on or off.

On	*Scan function on*

Press “SET” to accept the present setting and continue. Press “EXIT” to cancel.

SET	*Accept scan setting*

6.3.2 Scan Rate

The scan rate can be set from 0.1 to 99.9°C/min. The maximum scan rate, however, is actually limited by the natural heating or cooling rate of the instrument. This rate is often less than 100°C/min, especially when cooling.

The scan rate function appears in the main menu after the scan control function. The scan rate units are in degrees Celsius per minute, regardless of the selected units.

Sr	*Sr flashes for one second and then the current scan rate setting is displayed*
0.1	*Scan rate in°C/min*

Press the up or down arrow to change the scan rate.

2.0	*New scan rate*

Press “SET” to accept the new scan rate and continue. Press “EXIT” to cancel.

SET	*Accept scan rate*

6.4 Set-point Resistance

The set-point resistance is the resistance the instrument is trying to make the control sensor achieve and is calculated in the firmware using the set-point temperature. This value is not directly adjustable but is recalculated when the set-point temperature is

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changed. The set-point resistance is used to perform a calibration adjustment using the Callendar-Van Dusen R versus T curve fit (see Section , Calibration Procedure). The instrument must be at temperature and stable prior to taking the set-point resistance reading. The set-point resistance can be displayed by pressing the "SET" and ▼ simultaneously. The set-point resistance is displayed as follows.

SrES	SrES *flashes for two seconds and then the whole number of the current set-point resistance setting is displayed*
99.	*Whole number portion of the set-point resistance flashes for two seconds and then the fraction portion of the current set-point resistance setting is displayed*
.222	*Fraction portion of the current set-point resistance setting*

The set-point resistance is 99.222.

6.5 Secondary Menu

Functions which are used less often are accessed within the secondary menu. The secondary menu is accessed by pressing "SET" and "EXIT" simultaneously and then releasing. The first function in the secondary menu is the heater power display. (See Figure .)

6.6 Heater Power

The temperature controller controls the temperature of the well by pulsing the heater on and off. The total power being applied to the heater is determined by the duty cycle or the ratio of heater on time to the pulse cycle time. By knowing the amount of heating, the user can tell if the calibrator is heating up to the set-point, cooling down, or controlling at a constant temperature. Monitoring the percent heater power, allows the user to know the stability of the well temperature. With good control stability the percent heating power should not fluctuate more than ±5% within one minute.

The heater power display is accessed in the secondary menu. Press "SET" and "EXIT" simultaneously and release. The heater power is displayed as a percentage of full power.

100.0 C	*Well temperature*
SET + EXIT	*Access heater power in secondary menu*
SEC	*Flashes SEC for secondary menu and then displays the heater power*
12.0P	*Heater power in percent*

To exit out of the secondary menu press "EXIT". To continue on to the proportional band setting function press "SET".

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6.7 Proportional Band

In a proportional controller such as this, the heater output power is proportional to the well temperature over a limited range of temperatures around the set-point. This range of temperature is called the proportional band. At the bottom of the proportional band, the heater output is 100%. At the top of the proportional band, the heater output is 0. Thus, as the temperature rises the heater power is reduced, which consequently tends to lower the temperature back down. In this way the temperature is maintained at a constant level.

The temperature stability of the well and response time depend on the width of the proportional band. If the band is too wide, the well temperature deviates excessively from the set-point due to varying external conditions. This is because the power output changes very little with temperature and the controller cannot respond very well to changing conditions or noise in the system. If the proportional band is too narrow, the temperature may swing back and forth because the controller overreacts to temperature variations. For best control stability, the proportional band must be set for the optimum width.

The proportional band width is set at the factory as printed on the Report of Calibration. The proportional band width may be altered by the user if desired to optimize the control characteristics for a particular application.

The proportional band width is easily adjusted from the front panel. The width may be set to discrete values in degrees C or F depending on the selected units. The proportional band adjustment is accessed within the secondary menu. Press “SET” and “EXIT” to enter the secondary menu and show the heater power. Then press “SET” to access the proportional band.

SET + EXIT	*Access heater power in secondary menu*
SEC	*Flashes SEC for secondary menu and then displays the heater power*
12.0P	*Heater power in percent*
SET	*Access proportional band*
PrOP	*Flashes prop and then displays the setting*
4.1	*Proportional band setting*

To change the proportional band press ▲ or ▼.

10.0	*New proportional band setting*

To accept the new setting press “SET”. Press “EXIT” to continue without storing the new value.

SET	*Accept the new proportional band setting*

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6.8 Controller Configuration

The controller has a number of configuration and operating options and calibration parameters which are programmable via the front panel. These are accessed from the secondary menu after the proportional band function by pressing “SET”. Pressing “SET” again enters the first of three sets of configuration parameters — operating parameters, serial interface parameters, and calibration parameters. The menus are selected using the up and down arrows and then pressing “SET”.

6.9 Operating Parameters

The operating parameters menu is indicated by,

PAr	*Operating parameters menu*

The operating parameters menu contains the High Limit parameter.

6.10 High Limit

The High Limit parameter adjusts the upper set-point temperature. The factory default and maximum are set to 125°C (257°F). The minimum setting is 50°C (122°F). For safety, a user can adjust the High Limit down so the maximum temperature set-point is restricted.

HL	*Flashes HL and then displays the setting*
125	*Flashes the current value and then displays the value for adjustment*
125	*Current High Limit setting*

Press the ▲ or ▼ to adjust the setting.

100	*New High Limit setting*

To accept the new setting, press “SET”. Press “EXIT” to continue without storing the new value.

SET	*Accept the new High Limit setting*

6.11 Serial Interface Parameters

The serial RS-232 interface parameters menu is indicated by,

SErL	*Serial RS-232 interface parameters menu*

Press “SET” to enter the menu. The serial interface parameters menu contains parameters which determine the operation of the serial interface. The parameters in the menu are — baud rate, sample period, duplex mode, and linefeed.

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6.11.1 Baud Rate

The baud rate is the first parameter in the menu. The baud rate setting determines the serial communications transmission rate.

The baud rate parameter is indicated by,

bAUd	*Flashes bAUd for one second and then displays the setting*
2400b	*Current baud rate*

The BAUD rate of the serial communications may be programmed to 300, 600, 1200, **2400** (default), 4800, or 9600 BAUD. Use the up or down arrows to change the BAUD rate value.

4800 b	*New baud rate*

Press "SET" to accept the new setting or "EXIT" to abort the operation and skip to the next parameter in the menu.

6.11.2 Sample Period

The sample period is the next parameter in the serial interface parameter menu. The sample period is the time period in seconds between temperature measurements transmitted from the serial interface. If the sample rate is set to 5, the instrument transmits the current measurement over the serial interface approximately every five seconds. The automatic sampling is disabled with a sample period of 0. The sample period is indicated by,

SPEr	*Flashes for one second and then the serial sample period setting is displayed*
1	*Current sample period (seconds)*

Adjust the value by using the up or down arrows (▲ ▼).

60	*New sample period*

Press "SET" to accept the new setting or "EXIT" to abort the operation and skip to the next parameter in the menu.

6.11.3 Duplex Mode

The next parameter is the duplex mode. The duplex mode may be set to full duplex or half duplex. With full duplex any commands received by the calibrator via the serial interface are immediately echoed or transmitted back to the device of origin. With half duplex the commands are executed but not echoed. The duplex mode parameter is indicated by,

dUPL	*Flashes for one second and then the serial duplex mode setting is displayed*

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FULL *Current duplex mode setting*

The mode may be changed using the up or down arrows (▲ ▼).

HALF *New duplex mode setting*

Press "SET" to accept the new setting or "EXIT" to abort the operation and skip to the next parameter in the menu.

6.11.4 Linefeed

The final parameter in the serial interface menu is the linefeed mode. This parameter enables (on) or disables (off) transmission of a linefeed character (LF, ASCII 10) after transmission of any carriage-return. The linefeed parameter is indicated by,

LF *Flashes for one second and then the serial linefeed setting is displayed*

On *Current linefeed setting*

The mode may be changed using the up or down arrows (▲ ▼).

OFF *New linefeed setting*

Press "SET" to accept the new setting or "EXIT" to abort the operation and skip to the next parameter in the menu.

6.12 Calibration Parameters

The operator of the instrument controller has access to a number of the calibration constants: R0, ALPHA, and DELTA. These values are set at the factory and must not be altered. The correct values are important to the accuracy and proper and safe operation of the instrument. Access to these parameters is available to the user so that in the event that the controller memory fails the user may restore these values to the factory settings. The user should have a list of these constants and their settings with the instrument manual.

CAUTION: *DO NOT change the values of the instrument calibration constants from the factory set values. The correct setting of these parameters is important to the safety, proper operation, and performance of the instrument.*

The calibration parameters menu is indicated by,

CAL *Calibration parameters menu*

Press "SET" five times to enter the menu. The calibration parameters menu contains the parameters, Hard Cutout, R0, ALPHA, and DELTA, which characterize the resistance-temperature relationship of the platinum control sensor. These parameters may be adjusted to improve the accuracy of the calibrator.

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The calibration parameters are accessed by pressing “SET” after the name of the parameter is displayed. The value of the parameter may be changed using the up or down arrow. After the desired value is reached, press “SET” to set the parameter to the new value. Pressing “EXIT” causes the parameter to be skipped ignoring any changes that may have been made.

6.12.1 R0

This probe parameter refers to the resistance of the control probe at 0°C. The value of this parameter is set at the factory for best instrument accuracy. The value ranges from 95 to 105. For values greater than 100.000, the display does not show the hundreds placement. For values less than 100.000, the display shows the entire value. The R0 parameter is indicated by,

`r 0` *Flashes for one second and then the R0 setting is displayed*

`00.014` *Current R0 setting (100.014)*

To change the R0 setting, press the up or down arrows.

`99.999` *New R0 setting*

To accept the new setting, press “SET”. Press “EXIT” to continue without storing the new value.

SET *Accept the new R0 setting*

6.12.2 ALPHA

This probe parameter refers to the average sensitivity of the probe between 0 and 100°C. The value of this parameter is set at the factory for best instrument accuracy.

`ALPhA` *Flashes for one second and then the ALPHA setting is displayed*

`38530` *Current ALPHA setting*

To change the ALPHA setting, press the up or down arrows.

`38600` *New ALPHA setting*

To accept the new setting, press “SET”. Press “EXIT” to continue without storing the new value.

SET *Accept the new ALPHA setting*

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6.12.3 DELTA

This probe parameter characterizes the curvature of the resistance-temperature relationship of the sensor. The value of this parameter is set at the factory for best instrument accuracy.

DELtA	*Flashes for one second and then the DELTA setting is displayed*
0.0000	*Current DELTA setting*

To change the DELTA setting, press the up or down arrows.

0.1000	*New DELTA setting*

To accept the new setting, press “SET”. Press “EXIT” to continue without storing the new value.

SET	*Accept the new DELTA setting*

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7 Digital Communication Interface

This instrument is capable of communicating with and being controlled by other equipment through the digital serial interface.

With a digital interface, the instrument may be connected to a computer or other equipment. This allows the user to set the set-point temperature, monitor the temperature, and access any of the other controller functions, all using remote communications equipment. Communications commands are summarized in Table 4 on next page.

7.1 RS-232 Connection

The three-conductor jack for the serial port is located on the back of the instrument. One serial cable is included. Additional or longer cables, of three meters or less, can be constructed by following the wiring diagram shown in Figure 5 on this page. **Note:** The TxD line on one side connects to the RxD line on the other and vice-versa. To reduce the possibility of electrical interference, the serial cable should be shielded with low resistance between the connector and the shield and should not be much longer than is necessary. The protocol for serial communications is 8 data bits, 1 stop bit, and no parity. Use no flow control. Set the linefeed to ON (all carriage returns are followed by a linefeed (LF, ASCII 10)), and the duplex to HALF, disabling echo.

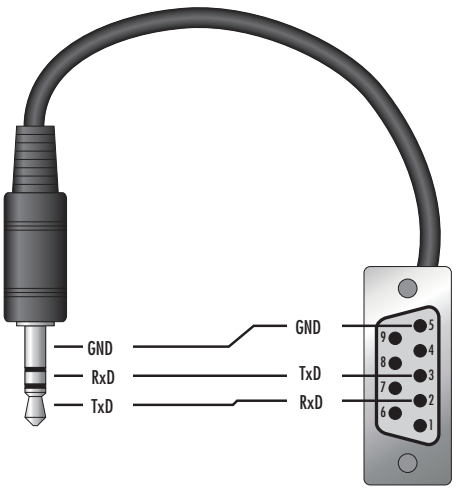

Figure 5 *Serial Cable Wiring*

The serial port can be used to transmit measurements to a computer or printer or to change settings of the instrument from a computer. A full list of commands follows in Section 7.2, Interface Commands, on page 32.

Commands sent to the instrument must end with an EOS character which is a carriage return (CR, ASCII 13) or linefeed character (LF, ASCII 10). Commands can be sent with upper or lower case letters. Data returned from the instrument end with a carriage return. If the linefeed setting is on, a linefeed is also sent after the carriage return.

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7.2 Interface Commands

The various commands for accessing the calibrator functions via the digital interface are listed in this section (see Table 4 on this page). These commands are used with the RS-232 serial interface. The commands are terminated with a carriage-return character (CR, ASCII 13). The interface makes no distinction between upper and lower case letters, hence either may be used. Commands may be abbreviated to the minimum number of letters which determines a unique command. A command may be used to either set a parameter or display a parameter depending on whether or not a value is sent with the command following a "=" character. For example "s" returns the current set-point and "s=120.0" sets the set-point to 120.0 degrees.

In the following list of commands, characters or data within brackets, "[" and "]", are optional for the command. A slash, "/", denotes alternate characters or data. Numeric data, denoted by "n", may be entered in decimal or exponential notation. Characters are shown in lower case although upper case may be used. Spaces may be added within command strings and will simply be ignored. Backspace (BS, ASCII 8) may be used to erase the previous character. A terminating carriage return (CR, ASCII 13) is implied with all commands.

Table 4 *Controller communications commands*

Command Description	Command Format	Command Example	Returned	Returned Example	Acceptable Values
Display Temperature					
Read current set-point	s[etpoint]	s	set: 999.99 {C or F}	set: 75.00 C	
Set current set-point to n	s[etpoint]=n t[emperature]=*n*	s=100 t=100			–10 to 122°C 14 to 252°F
Read temperature	t[emperature]	t	t: 999.9 {C or F}	t: 55.6 C	
Read temperature units	u[nits]	u	u: x	u: C	
Set temperature units:	**u[nits]=c/f**				C or F
Set temperature units to Celsius	u[nits]=c	u=c			
Set temperature units to Fahrenheit	u[nits]=f	u=f			
Read scan mode	sc[an]	sc	sc: {ON or OFF}	sc: ON	
Set scan mode	sc[an]=on/off	sc=on			ON or OFF
Read scan rate	sr[ate]	sr	srat: 99.9 {C or F}/min	srat:12.4 C/min	
Set scan rate	sr[ate]=n	sr=1.1			0.1 to 99.9°C 0.2 to 179.8°F
Secondary Menu					
Read proportional band setting	pr[op-band]	pr	pb: 999.99999	pb: 15.9	
Set proportional band to *n*	pr[op-band]=n	pr=8.83			0.1 to 30°C 0.2 to 54°F
Read heater power (duty cycle)	po[wer]	po	po: 999.9	po: 6.5	
Configuration Menu					
Operating Parameters Menu					
Read High Limit	hl[imit]	hl	hl: 9999	hl: 125	
Set High Limit	hl[imit]=n	hl=100			50 to 125°C 122 to 257°F

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Command Description	Command Format	Command Example	Returned	Returned Example	Acceptable Values
Serial Interface Menu					
Read serial sample setting	sa[mple]	sa	sa: 99999	sa: 1	
Set serial sampling setting to *n* seconds	sa[mple]=n	sa=0			0 to 10,000
Set serial duplex mode:	**du[plex]=f[ull]/ h[alf]**				FULL or HALF
Set serial duplex mode to full	du[plex]=f[ull]	du=f			
Set serial duplex mode to half	du[plex]=h[alf]	du=h			
Set serial linefeed mode:	**lf[eed]=on/of[f]**				ON or OFF
Set serial linefeed mode to on	lf[eed]=on	lf=on			
Set serial linefeed mode to off	lf[eed]=of[f]	lf=of			
Calibration Menu					
Read R0 calibration parameter	r[0]	r	r0: 999.999	r0: 100.7	
Set R0 calibration parameter to *n*	r[0]=n	r=100.7			95.0 to 105.0
Read ALPHA calibration parameter	al[pha]	al	al: 9.99999999	al: 0.003865	
Set ALPHA calibration parameter to *n*	al[pha]=n	al=0.003865			0.002 to 0.006
Read DELTA calibration parameter	de[lta]	de		de: 1.50	
Set DELTA calibration parameter	de[lta]=n	de=1.37	de: 9.99999		0.0–3.0
Miscellaneous Other Commands					
Read firmware version number	*ver[sion]	*ver	ver.9999x,9.99	ver.9102S,1.10	
Read structure of all commands	h[elp]	h	list of commands		
Read ALL operating parameters	all	all	list of parameters		
Read set-point	*sr	*sr	999.999 ohms	100.123 ohms	

Legend: [] Optional command data
{} Returns either information
n Numeric data supplied by user
9 Numeric data returned to user
x Character data returned to user

Note: When DUPLEX is set to FULL and a command is sent to READ, the command is returned followed by a carriage return and linefeed. Then the value is returned as indicated in the RETURNED column.

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8 Test Probe Calibration

For optimum accuracy and stability, allow the calibrator to warm up for 10 minutes after power-up and then allow adequate stabilization time after reaching the set-point temperature. After completing operation of the calibrator, allow the well to cool by setting the temperature to 25°C for one-half hour before switching the power off.

8.1 Calibrating a Single Probe

Insert the probe to be calibrated into the well of the instrument. The probe should fit snugly into the calibrator probe sleeve yet should not be so tight that it cannot be easily removed. Avoid any dirt or grit that may cause the probe to jam into the sleeve. Best results are obtained with the probe inserted to the full depth of the well. Once the probe is inserted into the well, allow adequate stabilization time to allow the test probe temperature to settle as described above. Once the probe has settled to the temperature of the well, it may be compared to the calibrator display temperature. The display temperature should be stable to within ±0.05°C degree for best results.

CAUTION: *Never allow foreign material into the wells of the block. Fluids and other materials can damage the instrument causing binding and damage to your probe.*

8.2 Dry-well Characteristics

There is a temperature gradient vertically in the test well. The heater has been applied to the block in such a way as to compensate for nominal heat losses out of the top of the dry-well. However, actual heat losses vary with design of the thermometer probes inserted into the calibrator and the temperature. For best results, insert probe to full depth of well.

8.2.1 Stabilization and Accuracy

The stabilization time of the instrument depends on the conditions and temperatures involved. Typically, the test well stabilizes to ±0.05°C within 7 minutes of reaching the set-point temperature as indicated by the display. Ultimate stability is achieved 10 to 20 minutes after reaching the set temperature.

Depending on the magnitude of the disturbance and the required accuracy, inserting a cold probe into a warm well will require another stabilization period. For example, inserting a 0.25 inch diameter room temperature probe into a sleeve at 120°C takes 7 minutes to be within ±0.05°C of its settled point and might take 15 minutes to achieve maximum stability.

Speeding up the calibration process can be accomplished by knowing how soon to make the measurement. It is recommended that typical measurements be made at the desired temperatures with the desired test probes to establish these times.

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9 Calibration Procedure

Note: *This procedure is to be considered a general guideline. Each laboratory should write their own procedure based on their equipment and their quality program. Each procedure should be accompanied by an uncertainty analysis also based on the laboratory's equipment and environment.*

Sometimes the user may want to calibrate the dry-well to improve the temperature set-point accuracy. Calibration is done by adjusting the controller probe calibration constants **R0** , **ALPHA,** and **DELTA** so that the temperature of the dry-well as measured with a standard thermometer agrees more closely with the set-point. The thermometer used must be able to measure the well temperature with higher accuracy than the desired accuracy of the dry-well. By using a good thermometer and following this procedure the dry-well can be calibrated to an accuracy of better than 0.25°C over its full range.

9.1 Calibration Points

In calibrating the dry-well, **R0**, **ALPHA**, and **DELTA** are adjusted to minimize the set-point error at each of three different dry-well temperatures. Any three reasonably separated temperatures may be used for the calibration. Improved results can be obtained for shorter ranges when using temperatures that are just within the most useful operating range of the dry-well. The farther apart the calibration temperatures, the greater the calibrated temperature range. However, the calibration error is also greater over the range. For instance, if 10°C to 100°C is chosen as the calibration range, the calibrator may achieve an accuracy of ±0.25°C over the range 10°C to 100°C. Choosing a range of 50°C to 100°C may allow the calibrator to have a better accuracy of maybe ±0.2°C over the range 75°C to 105°C but outside that range the accuracy may be only ±0.25°C.

9.2 Calibration Procedure

1. Choose three set-points to use in the calibration of the R0, ALPHA, and DELTA parameters. These set points are generally 2°C, 50°C, and 100°C but other set points may be used if desired or necessary.
2. Set the dry-well to the lowest set-point. When the dry-well reaches the set-point and the display is stable, wait 15 minutes or so and then take a reading from the thermometer. Sample the set-point resistance by holding down "SET" and pressing the ▼. Write these values down as T_1 and R_1 respectively.
3. Repeat step 2 for the other two set-points recording them as T_2 and R_2 and T_3 and R_3 respectively.
4. Using the recorded data, calculate new values for the R0, ALPHA, and DELTA.

9.2.1 Compute DELTA

$$A = T_3 - T_2$$

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$$B = T_2 - T_1$$

$$C = \left[\frac{T_3}{100}\right]\left[1 - \frac{T_3}{100}\right] - \left[\frac{T_2}{100}\right]\left[1 - \frac{T_2}{100}\right]$$

$$D = \left[\frac{T_2}{100}\right]\left[1 - \frac{T_2}{100}\right] - \left[\frac{T_1}{100}\right]\left[1 - \frac{T_1}{100}\right]$$

$$E = R_3 - T_2$$

$$F = R_2 - T_1$$

$$delta = \frac{AF - BE}{DE - CF}$$

$\mathbf{T_{1\text{-}3}}$ - Measured temperature using thermometer.

$\mathbf{R_{1\text{-}3}}$ - Value of set-point resistance from the instrument display. (Press "SET" and ▼ at the same time.)

where

$\mathbf{T_1}$ and $\mathbf{R_1}$ are the measured temperature and set-point resistance at 2.0 °C

$\mathbf{T_2}$ and $\mathbf{R_2}$ are the measured temperature and set-point resistance at 50.0 °C

$\mathbf{T_3}$ and $\mathbf{R_3}$ are the measured temperature and set-point resistance at 100.0 °C

9.2.2 Compute R0 and ALPHA

$$a_1 = T_1 + delta\left[\frac{T_1}{100}\right]\left[1 - \frac{T_1}{100}\right]$$

$$a_3 = T_3 + delta\left[\frac{T_3}{100}\right]\left[1 - \frac{T_3}{100}\right]$$

$$rzero = \frac{R_3 a_1 - R_1 a_3}{a_1 - a_3}$$

$$alpha = \frac{R_1 - R_3}{R_3 a_1 - R_1 a_3}$$

delta is the new value of DELTA computed above

Program the new values for DELTA (delta), R0 (rzero), and ALPHA (alpha) into the dry-well using the following steps.

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5. Press “SET” and “EXIT” at the same time. Press “SET” until PAR is displayed. and then press ▲ until CAL is displayed.
6. Press “SET” five times to enter the menu.
7. Press “SET” and ▲ or ▼ until the correct numerical setting is displayed. Press “SET” to accept the new value.
8. Repeat step 3. for ALPHA and DELTA.
9. Press “EXIT” to show the displayed temperature.

9.2.3 Accuracy and Repeatability

Check the accuracy of the dry-well at various points over the calibration range. If dry-well does not pass specification at all set-points, repeat the Calibration Procedure.

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10 Maintenance

- This instrument has been designed with the utmost care. Ease of operation and simplicity of maintenance have been a central theme in the product development. Therefore, with proper care the instrument should require very little maintenance. Avoid operating the instrument in an oily, wet, dirty, or dusty environment.
- If the outside of the instrument becomes soiled, it may be wiped clean with a damp cloth and mild detergent. Do not use harsh chemicals on the surface which may damage the paint.
- It is important to keep the well of the calibrator clean and clear of any foreign matter. Do not use fluid to clean out the well.
- Use a commercially available plastic or felt brush, of appropriate diameter for a tight fit without any fluid, to clean the well. Complete the cleaning process by using cotton swabs and air to remove any debris.
- Inserts should be cleaned periodically. For cold dry-wells operating below 0°C, you should always clean the inserts after operating the unit at or below 0°C. Use emery cloth or other similar material to clean the outside of the inserts. Ensure that the inserts are wiped clean of any debris loosened in the buffing process. Periodic cleaning of the outside of the inserts ensures easy insertion and removal of the inserts from the well.
- The dry-well calibrator should be handled with care. Avoid knocking or dropping the calibrator.
- Do not drop the probe stems into the well. This type of action can cause a shock to the sensor.
- If a hazardous material is spilt on or inside the equipment, the user is responsible for taking the appropriate decontamination steps as outlined by the national safety council with respect to the material.
- If the mains supply cord becomes damaged, replace it with a cord with the appropriate gauge wire for the current of the instrument. If there are any questions, call an Authorized Service Center (see Section 1.4, Authorized Service Centers, on page 6) for more information.
- Before using any cleaning or decontamination method except those recommended by Fluke, users should check with an Authorized Service Center to be sure that the proposed method will not damage the equipment.
- If the instrument is used in a manner not in accordance with the equipment design, the operation of the dry-well may be impaired or safety hazards may arise.

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11 Troubleshooting

This section contains information on troubleshooting, CE Comments, and a wiring diagram.

11.1 Troubleshooting Problems, Possible Causes, and Solutions

In the event that the instrument appears to function abnormally, this section may help to find and solve the problem. Several possible problem conditions are described along with likely causes and solutions. If a problem arises, please read this section carefully and attempt to understand and solve the problem. If the problem cannot otherwise be solved, contact an Authorized Service Center (see Section 1.4, Authorized Service Centers, on page 6) for assistance. Be sure to have the model number, serial number, voltage, and problem description available.

Problem	Possible Causes and Solutions
Incorrect temperature reading	**Incorrect R0, ALPHA, and DELTA parameters.** Find the value for R0, ALPHA, and DELTA on the Report of Calibration. Reprogram the parameters into the instrument (see Section , Calibration Parameters). Allow the instrument to stabilize and verify the accuracy of the temperature reading. **Controller locked up.** The controller may have locked up due to a power surge or other aberration. Initialize the system by performing the Factory Reset Sequence. **Factory Reset Sequence.** Hold the SET and EXIT buttons down at the same time while powering up the instrument. The instrument displays shows '-init-'; the model number, and the firmware version. Each of the controller parameters and calibration constants must be reprogrammed. The values can be found on the Report of Calibration (see Section 6.12, Calibration Parameters, on page 27).
The instrument heats or cools too quickly or too slowly	**Incorrect scan and scan rate settings.** The scan and scan rate settings may be set to unwanted values. Check the Scan and Scan Rate settings. The scan may be off (if the unit seems to be responding too quickly). The scan may be on with the Scan Rate set low (if unit seems to be responding too slowly). **Improper line voltage.** Verify that the voltage reading in the bottom of the unit matches the source voltage.
Unstable display	**Wait.** Allow the instrument to stabilize for a few minutes. **Proportional band may be incorrect.** Refer to the proportional band on the Report of Calibration.
The display shows an error code	**Controller problem.** The error messages signify the following problems with the controller. Err 1 - a RAM error Err 2 - a NVRAM error Err 3 - a Structure error Err 4 - an ADC setup error Err 5 - an ADC ready error Err 6 – a defective control sensor Err 7 – a heater error Initialize the system by performing the Factory Reset Sequence describe above.
Temperature cannot be set above a certain point	**Incorrect High Limit parameter.** The High Limit parameter may be set below 125°C. Check this value as described in Section 6.9, Operating Parameters, on page 25.
Display is reading incorrectly	The instrument was turned off at high temperatures and reenergized too quickly. Turn the instrument off until the display is completely off and then reenergize.
Display flickers when the instrument is turned off	This is normal operation and is more prevalent at high temperatures due to Seebeck Coefficient of the thermoelectric cooling devices. Some time is required to fully discharge the switching power supply and to complete the power off cycle.

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Problem	Possible Causes and Solutions
The instrument does not reach temperature	The specifications for the instrument include an ambient temperature of 23°C. If the ambient temperature is above 23°C, the instrument may not be able to reach the lowest specified temperature. Check the ambient temperature if the instrument does not reach maximum temperature.

11.2 CE Comments

11.2.1 EMC Directive

Fluke's equipment has been tested to meet the European Electromagnetic Compatibility Directive (EMC Directive, 89/336/EEC). The Declaration of Conformity for your instrument lists the specific standards to which the unit was tested.

11.2.2 Low Voltage Directive (Safety)

In order to comply with the European Low Voltage Directive (73/23/EEC), Fluke equipment has been designed to meet the IEC 1010-1 (EN 61010-1) and the IEC 1010-2-010 (EN 61010-2-010) standards.

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